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## JUST A HEAD

### *Decapitation, reanimation, and the human head transplant*

If you really wanted to know for sure that the human soul resides in the brain, you could cut off a man's head and ask it. You would have to ask quickly, for the human brain cut off from its blood supply will slide into unconsciousness after ten or twelve seconds. You would, further, have to instruct the man to answer with blinks, for, having been divorced from his lungs, he can pull no air through his larynx and thus can no longer speak. But it could be done. And if the man seemed more or less the same individual he was before you cut off his head, perhaps a little less calm, then you would know that indeed the self is there in the brain.

In Paris, in 1795, an experiment very much like this was nearly undertaken. Four years before, the guillotine had replaced the noose as the executioner's official tool. The device was named after Dr. Joseph Ignace Guillotin, though he did not invent it. He merely lobbied for its use, on the grounds that the decapitating machine, as he preferred to call it, was an instantaneous, and thus more humane, way to kill.

And then he read this:

Do you know that it is not at all certain when a head is severed from the body by the guillotine that the feelings, per-

sonality and ego are instantaneously abolished . . . ? Don't you know that the seat of the feelings and appreciation is in the brain, that this seat of consciousness can continue to operate even when the circulation of the blood is cut off from the brain . . . ? Thus, for as long as the brain retains its vital force the victim is aware of his existence. Remember that Haller insists that a head, having been removed from the shoulders of a man, grimaced horribly when a surgeon who was present struck a finger into the rachidian canal . . . Furthermore, credible witnesses have assured me that they have seen the teeth grind after the head has been separated from the trunk. And I am convinced that if the air could still circulate through the organs of the voice . . . these heads would speak . . .

. . . The guillotine is a terrible torture! We must return to hanging.

It was a letter, published in the November 9, 1795, Paris *Moniteur* (and reprinted in André Soubiran's biography of Guillotin), written by the well-respected German anatomist S. T. Sömmering. Guillotin was horrified, the Paris medical community awriter. Jean-Joseph Sue, the librarian at the Paris School of Medicine, came out in agreement with Sömmering, declaring his belief that the heads could see hear, smell, see, and think. He tried to convince his colleagues to undertake an experiment whereby "before the butchery of the victim," a few of the unfortunate's friends would arrange a code of eyelid or jaw movements which the head could use after the execution to indicate whether it was "fully conscious of [its] agony." Sue's colleagues in the medical community dismissed his idea as ghastly and absurd, and the experiment was not carried out. Nonetheless, the notion of the living head had made its way into the public consciousness and even popular literature. Below is a conversation between a pair of fictional executioners, in Alexandre Dumas's *Mille et Un Phantomes*:

"Do you believe they're dead because they've been guillotined?"

"Undoubtedly!"

"Well, one can see that you don't look in the basket when they are all there together. You've never seen them twist their eyes and grind their teeth for a good five minutes after the execution. We are forced to change the basket every three months because they cause such damage to the bottom."

Shortly after Sömmering's and Sue's pronouncements, Georges Martin, an assistant to the official Paris executioner and witness to some 120 beheadings, was interviewed on the subject of the heads and their post-execution activities. Soubiran writes that he cast his lot (not surprisingly) on the side of instantaneous death. He claimed to have viewed all 120 heads within two seconds and always "the eyes were fixed . . . The immobility of the lids was total. The lips were already white . . ." Medical science was, for the moment, reassured, and the furor dissipated.

But French science was not through with heads. A physiologist named Legallois surmised in an 1812 paper that if the personality did indeed reside in the brain, it should be possible to revive *une tête séparée du tronc* by giving it an injection of oxygenated blood through its severed cerebral arteries. "If a physiologist attempted this experiment on the head of a guillotined man a few instants after death," wrote Legallois's colleague Professor Vulpian, "he would perhaps bear witness to a terrible sight." Theoretically, for as long as the blood supply lasted, the head would be able to think, hear, see, smell (grind its teeth, twist its eyes, chew up the lab table), for all the nerves above the neck would still be intact and attached to the organs and muscles of the head. The head wouldn't be able to speak, owing to the aforementioned disabling of the larynx, but this was probably, from the perspective of the experimenter, just as well. Legallois lacked either the resources or the intestinal fortitude to

follow through with the actual experiment, but other researchers did not.

In 1857, the French physician Brown-Séquard cut the head off a dog ("*Je décapiai un chien . . .*") to see if he could put it back in action with arterial injections of oxygenated blood. Eight minutes after the head parted company with the neck, the injections began. Two or three minutes later, Brown-Séquard noted movements of the eyes and facial muscles that appeared to him to be voluntarily directed. Clearly something was going on in the animal's brain.

With the steady supply of guillotined heads in Paris, it was only a matter of time before someone tried this out on a human. There could be only one man for the job, a man who would more than once make a name for himself (lots of names, probably) by doing peculiar things to bodies with the aim of resuscitating them. The man for the job was Jean Baptiste Vincent Laborde, the very same Jean Baptiste Vincent Laborde who appeared earlier in these pages advocating prolonged tongue-pulling as a means of reviving the comatose, mistaken-for-dead patient. In 1884, the French authorities began supplying Laborde with the heads of guillotined prisoners so that he could examine the state of their brain and nervous system. (Reports of these experiments appeared in various French medical journals, *Revue Scientifique* being the main one.) It was hoped that Laborde would get to the bottom of what he called *la terrible legende*—that it was possible for guillotined heads to be aware, if only for a moment, of their situation (in a basket, without a body). Upon a head's arrival in his lab, he would quickly bore holes in the skull and insert needles into the brain in an attempt to trigger nervous system responses. Following Brown-Séquard's lead, he also tried resuscitating the heads with a supply of blood.

Laborde's first subject was a murderer named Campi. From Laborde's description, he was not a typical thug. He had delicate ankles and white, well-manicured hands. His skin was unblem-

ished save for an abrasion on the left cheek, which Laborde surmised was the result of the head's drop into the guillotine basket. Laborde didn't typically spend so much time personalizing his subjects, preferring to call them simply *restes frais*. The term means, literally, "fresh remains," though in French it has a pleasant culinary lilt, like something you might order off the specials board at the neighborhood bistro.

Campi arrived in two pieces, and he arrived late. Under ideal circumstances, the distance from the scaffold to Laborde's lab on Rue Vauquelin could be covered in about seven minutes. Campi's commute took an hour and twenty minutes, owing to what Laborde called "that stupid law" forbidding scientists to take possession of the remains of executed criminals until the bodies had crossed the threshold of the city cemetery. This meant Laborde's driver had to follow the heads as they "made the sentimental journey to the turnip field" (if my French serves) and then pack them up and bring them all the way back across town to the lab. Needless to say, Campi's brain had long since ceased to function in anything close to a normal state.

Infrustrated by the waste of eighty critical postmortem minutes, Laborde decided to meet his next head at the cemetery gates and set directly to work on it. He and his assistants rigged a makeshift traveling laboratory in the back of a horse-drawn van, complete with lab table, five stools, candles, and the necessary equipment. The second subject was named Gamahut, a fact unlikely to be forgotten, owing to the man's having had his name tattooed on his torso. Eerily, as though preaging his gory fate, he had also been tattooed with a portrait of himself from the neck up, which, without the lines of a frame to suggest an unseen body, gave him the appearance of a floating head.

Within minutes of its arrival in the van, Gamahut's head was installed in a styptic-lined container and the men set to work, drilling holes in the skull and inserting needles into various regions of the brain to see if they could coax any activity out of

the criminal's moribund nervous system. The ability to perform brain surgery while traveling full tilt on a cobblestone street is a testament to the steadiness of Laborde's hand and/or the craftsmanship of nineteenth-century broughams. Had the vehicle's manufacturers known, they might have crafted a persuasive advertisement, à la the diamond cutter in the backseat of the smooth-riding Oldsmobile.

Laborde's team ran current through the needles, and the Gamahut head could be seen to make the predictable twitches of lip and jaw. At one point—to the astonished shouts of all present—the prisoner slowly opened one eye, as if, with great and understandable trepidation, he sought to figure out where he was and what sort of strange locality hell had turned out to be. But, of course, given the amount of time that had elapsed, the movement could have been nothing beyond a primitive reflex.

The third time around, Laborde resorted to basic bribery to expedite his head deliveries. With the help of the local municipality chief, the third head, that of a man named Gagny, was delivered to his lab just shy of seven minutes after the chop. The arteries on the right side of the neck were injected with oxygenated cow's blood, and, in a break from Brown-Séguard's protocol, the arteries on the other side were connected to those of a living animal: *un chien vigoureux*. Laborde had an arresting flair for details, which the medical journals of his day seemed pleased to accommodate. He devoted a full paragraph to an artful description of a severed head resting upright on the lab table, rocking ever so slightly left and right from the pulsing pressure of the dog's blood as it pumped into the head. In another paper, he took pains to detail the postmortem contents of Gamahut's excretory organs, though the information bore no relation to the experiment at hand, noting with seeming fascination that the stomach and intestines were completely empty save for *un petit bouchon fécal* at the far end.

With the Gagny head, Laborde came closest to restoring normal brain function. Muscles on the eyelids, forehead, and jaw could be made to contract. At one point Gagny's jaw snapped shut so forcefully that a loud *claquement dentaire* was heard. However, given that twenty minutes had passed from the drop of the blade to the infusion of blood—and irreversible brain death sets in after six to ten minutes—it is certain that Gagny's brain was too far gone to be brought around to anything resembling consciousness and he remained blessedly ignorant of his dismaying state of affairs. The *chien*, on the other hand, spent its final, decidedly less *vigoureux* minutes watching its blood pump into someone else's head and no doubt produced some *claquements dentaires* of its own.

Laborde soon lost interest in heads, but a team of French experimenters named Hayem and Barrier took up where he left off. The two became something of a cottage industry, transfusing a total of twenty-two dog heads, using blood from live horses and dogs. They built a tabletop guillotine specially fitted to the canine neck and published papers on the three phases of neurological activity following decapitation. Monsieur Guillotin would have been deeply chagrined to read the concluding statements in Hayem and Barrier's description of the initial, or "convulsive," postdecapitation phase. The physiognomy of the head, they wrote, expresses surprise or "*une grande anxiété*," and appears to be conscious of the exterior world for three or four seconds.

Eighteen years later, a French physician by the name of Beau-riex confirmed Hayem and Barrier's observations—and Sömmering's suspicions. Using Paris's public scaffold as his lab, he carried out a series of simple observations and experiments on the head of a prisoner named Languille, the instant after the guillotine blade dropped.

Here, then, is what I was able to note immediately after the decapitation: the eyelids and lips of the guillotined man worked

in irregularly rhythmic contractions for about five or six seconds . . . [and] ceased. The face relaxed, the lids half closed on the eyeballs, . . . exactly as in the dying whom we have occasion to see every day in the exercise of our profession. . . . It was then that I called in a strong, sharp voice, "Languille!" I then saw the eyelids slowly lift up, without any spasmodic contraction . . . such as happens in everyday life, with people awakened or torn from their thoughts. Next Languille's eyes very definitely fixed themselves on mine and the pupils focused themselves. I was not, then, dealing with the sort of vague dull look without any expression that can be observed any day in dying people to whom one speaks. I was dealing with undeniably living eyes which were looking at me.

After several seconds, the eyelids closed again, slowly and evenly, and the head took on the same appearance as it had had before I called out. It was at that point that I called out again, and, once more, without any spasm, slowly, the eyelids lifted and undeniably living eyes fixed themselves on mine with perhaps even more penetration than the first time. . . . I attempted the effect of a third call; there was no further movement—and the eyes took on the glazed look which they have in the dead. . . .

You know, of course, where this is leading. It is leading toward human head transplants. If a brain—a personality—and its surrounding head can be kept functional with an outside blood supply for as long as that supply lasts, then why not go the whole hog and actually transplant it onto a living, breathing body, so that it has an ongoing blood supply? Here the pages fly from the calendar and the globe spins on its stand, and we find ourselves in St. Louis, Missouri, May 1908.

Charles Guthrie was a pioneer in the field of organ transplantation. He and a colleague, Alexis Carrel, were the first to

master the art of anastomosis: the stitching of one vessel to another without leaks. In those days, the task required great patience and dexterity, and very thin thread (at one point, Guthrie tried sewing with human hair). Having mastered the skill, Guthrie and Carrel went anastomosis-happy, transplanting pieces of dog thighs and entire forelimbs, keeping extra kidneys alive outside of bodies and stitching them into groins. Carrel went on to win the Nobel Prize for his contributions to medicine; Guthrie, the meeker and humbler of the two, was rudely overlooked.

On May 21, Guthrie succeeded in grafting one dog's head onto the side of another's neck, creating the world's first man-made two-headed dog. The arteries were grafted together such that the blood of the intact dog flowed through the head of the decapitated dog and then back into the intact dog's neck, where it proceeded to the brain and back into circulation. Guthrie's book *Blood Vessel Surgery and Its Applications* includes a photograph of the historic creature. Were it not for the caption, the photo would seem to be of some rare form of marsupial dog, with a large baby's head protruding from a pouch in its mother's fur. The transplanted head was sewn on at the base of the neck, upside down, so that the two dogs are chin to chin, giving an impression of intimacy, despite what must have been at the very least a strained coexistence. I imagine photographs of Guthrie and Carrel around that time having much the same quality.

As with Monsieur Gagny's head, too much time (twenty minutes) had elapsed between the beheading and the moment circulation was restored for the dog head and brain to regain much function. Guthrie recorded a series of primitive movements and basic reflexes, similar to what Laborde and Hayem had observed: pupil contractions, nostril twitchings, "boiling movements" of the tongue. Only one notation in Guthrie's lab notes gives the impression that the upside-down dog head might have had an awareness of what had taken place: "5:31:



Secretion of tears. . . .” Both dogs were euthanized when complications set in, about seven hours after the operation.

The first dog heads to enjoy, if that word can be used, full cerebral function were those of transplantation whiz Vladimir Demikhov, in the Soviet Union in the 1950s. Demikhov minimized the time that the severed donor head was without oxygen by using “blood-vessel sewing machines.” He transplanted twenty puppy heads—actually, head-shoulders-lungs-and-forelimbs units with an esophagus that emptied, untidily, onto the outside of the dog—onto fully grown dogs, to see what they’d do and how long they’d last (usually from two to six days, but in one case as long as twenty-nine days).

In his book *Experimental Transplantation of Vital Organs*, Demikhov includes photographs of, and lab notes from, Experiment No. 2, on February 24, 1954: the transplantation of a one-month-old puppy’s head and forelimbs to the neck of what appears to be a Siberian husky. The notes portray a lively, puppylike, if not altogether joyous existence on the part of the head:

09:00. The donor’s head eagerly drank water or milk, and tugged as if trying to separate itself from the recipient’s body.

22:30. When the recipient was put to bed, the transplanted head bit the finger of a member of the staff until it bled.

February 26, 18:00. The donor’s head bit the recipient behind the ear, so that the latter yelped and shook its head.

Demikhov’s transplant subjects were typically done in by immune reactions. Immunosuppressive drugs weren’t yet available, and the immune system of the intact dog would, understandably enough, treat the dog parts grafted to its neck as a hostile invader and proceed accordingly. And so Demikhov hit a wall. Having transplanted virtually every piece and combina-

tion of pieces of a dog into or onto another dog,\* he closed up his lab and disappeared into obscurity.

If Demikhov had known more about immunology, his career might have gone quite differently. He might have realized that the brain enjoys what is known as “immunological privilege,” and can be kept alive on another body’s blood supply for weeks without rejection. Because it is protected by the blood brain barrier, it isn’t rejected the way other organs and tissues are. While the mucosal tissues of Guthrie’s and Demikhov’s transplanted dog heads began swelling and hemorrhaging within a day or two of the operation, the brains at autopsy appeared normal.

Here is where it begins to get strange.

In the mid-1960s, a neurosurgeon named Robert White began experimenting with “isolated brain preparations”: a living brain taken out of one animal, hooked up to another animal’s circulatory system, and kept alive. Unlike Demikhov’s and Guthrie’s whole head transplants, these brains, lacking faces and sensory organs, would live a life confined to memory and thought. Given that many of these dogs’ and monkeys’ brains were implanted inside the necks and abdomens of other animals, this could only have been a blessing. While the inside of someone else’s abdomen is of moderate interest in a sort of curiosity-seeking, Surgery Channel sort of way, it’s not the sort of place you want to settle down in to live out the remainder of your years.

\* When he tired of moving organs and heads around, Demikhov moved on to entire dog halves. His book details an operation in which two dogs were split at the diaphragm, their upper and lower halves swapped, and their arteries grafted back together. He explained that this might be less time-consuming than transplanting two or three individual organs. Given that the patient’s spinal nerves, once severed, could not be reconnected and the lower half of the body would be paralyzed, the procedure failed to generate much enthusiasm.

White figured out that by cooling the brain during the procedure to slow the processes by which cellular damage occurs—a technique used today in organ recovery and transplant operations—it was possible to retain most of the organ's normal functions. Which means that the personality—the psyche, the spirit, the soul—of those monkeys continued to exist, for days on end, without its body or any of its senses, inside another animal. What must that have been like? What could possibly be the purpose, the justification? Had White been thinking of one day isolating a human brain like this? What kind of person comes up with a plan like this and carries it out?

To find out, I decided to go visit White in Cleveland, where he is spending his retirement. We planned to meet at the Metro Health Care Center, downstairs from the lab where he carried out his historic operations, which has been preserved as a kind of shrine-cum-media-photo-op. I was an hour early, and spent the time driving up and down Metro Health Care Drive, looking for a place to sit and have some coffee and review White's papers. There was nothing. I ended up back at the hospital, on a patch of grass outside the parking garage. I had heard Cleveland had undergone some sort of renaissance, but apparently it underwent it in some other part of town. Let's just say it wasn't the sort of place I'd want to live out the remainder of my years, though it beats a monkey abdomen, and you can't say that about some neighborhoods.

White escorts me through the hospital corridors and stairways, past the neurosurgery department, up the stairs, to his old lab. He is seventy-six now, thinner than he was at the time of the operations, but otherwise little changed by age. His answers have the rote, patient air you expect from a man who has been asked the same questions a hundred times.

"Here we are," says White. NEUROLOGICAL RESEARCH LABORATORY, says a plaque beside the door, giving away nothing. To step inside is to step back into 1968, before labs went white and

stainless. The counters are of a dull black stone, stained with white rings, and the cabinets and drawers are wood. It has been a while since anyone dusted, and ivy has grown over the one window. The fluorescent lights have those old covers that look like ice tray dividers.

"This is where we shouted 'Eureka!' and danced around," recalls White. There isn't much room for dancing. It's a small, cluttered, low-ceilinged room, with a couple of stools for the scientists, and a downsized veterinary operating table for the *thesus* monkeys.

And while White and his colleagues danced, what was going on inside the brain of that monkey? I ask him what he imagined it must have been like to find yourself, suddenly, reduced to your thoughts. I am, of course, not the first journalist to have asked this question. The legendary Oriana Fallaci\* asked it of White's neurophysiologist Leo Massopust, in a *Look* magazine interview in November 1967. "I suspect that without his senses he can think more quickly," Dr. Massopust answered brightly. "What kind of thinking, I don't know. I guess he's primarily a memory, a repository for information stored when he had his flesh; he cannot develop further because he no longer has the nourishment of experience. Yet this, too, is a new experience."

White declines to sugar-coat. He mentions the isolation chamber studies of the 1970s, wherein subjects had no sensory input, nothing to hear, see, smell, feel, or taste. These people got as close as you can come, without White's aid, to being brains in a box. "People [in these conditions] have gone literally, crazy,"

\* Legendary for skewering heads of state, from Kissinger to Arafat ("a man born to irritate"). Fallaci stuck it to White by making up a name for the anonymous lab monkey whose brain she had watched being isolated and for writing things like this: "While [the brain removal and hookup] happened, no one paid any attention to Libby's body, which was lying lifeless. Professor White might have fed it, too, with blood, and made it survive without a head. But Professor White didn't choose to, and so the body lay there, forgotten."

says White, "and it doesn't take all that long." Although insanity, too, is a new experience for most people, no one was likely to volunteer to become one of White's isolated brains. And of course, White couldn't force anyone to do it—though I imagine Oriana Fallaci came to mind. "Besides," says White, "I would question the scientific applicability. What would justify it?"

So what justified putting a rhesus monkey through it? It turns out the isolated brain experiments were simply a step on the way toward keeping entire heads alive on new bodies. By the time White appeared on the scene, early immunosuppressive drugs were available and many of the problems of tissue rejection were being resolved. If White and his team worked out the kinks with the brains and found they could be kept functioning, then they would move on to whole heads. First monkey heads, and then, they hoped, human ones.

Our conversation has moved from White's lab to a booth in a nearby Middle Eastern restaurant. My recommendation to you is that you never eat baba ganoush or, for that matter, any soft, glistening gray food item while carrying on a conversation involving monkey brains.

White thinks of the operation not as a head transplant, but as a whole-body transplant. Think of it this way: Instead of getting one or two donated organs, a dying recipient gets the entire body of a brain-dead beating-heart cadaver. Unlike Guthrie and Denikhor with their multihheaded monsters, White would remove the body donor's head and put the new one in its place. The logical recipient of this new body, as White envisions it, would be a quadriplegic. For one thing, White said, the life span of quadriplegics is typically reduced, their organs giving out more quickly than is normal. By putting them—their heads—onto new bodies, you would buy them a decade or two of life, without, in their case, much altering their quality of life. High-level quadriplegics are paralyzed from the neck down and require artificial respiration, but everything from the neck up

works fine. Ditto the transplanted head. Because no neurosurgeon can yet reconnect severed spinal nerves, the person would still be a quadriplegic—but no longer one with a death sentence. "The head could hear, taste, see," says White. "It could read, and hear music. And the neck can be instrumented just like Mr. Reeve's is, to speak."

In 1971, White achieved the unthinkable. He cut the head off one monkey and connected it to the base of the neck of a second, decapitated monkey. The operation lasted eight hours and required numerous assistants, each having been given detailed instructions, including where to stand and what to say. White went up to the operating room for weeks beforehand and marked off everyone's position on the floor with chalk circles and arrows, like a football coach. The first step was to give the monkeys tracheotomies and hook them up to respirators, for their windpipes were about to severed. Next White pared the two monkey's necks down to just the spine and the main blood vessels—the two carotid arteries carrying blood to the brain and the two jugular veins bringing it back to the heart. Then he whittled down the bone on the top of the body donor's neck and capped it with a metal plate, and did the same thing on the bottom of the head. (After the vessels were reconnected, the two plates were screwed together.) Then, using long, flexible tubing, he brought the circulation of the donor body over to supply its new head and sutured the vessels. Finally, the head was cut off from the blood supply of its old body.

This is, of course, grossly simplified. I make it sound as though the whole thing could be done with a jackknife and a sewing kit. For more details, I would direct you to the July 1971 issue of *Surgery*, which contains White's paper on the procedure, complete with pen-and-ink illustrations. My favorite illustration shows a monkey body with a faint, ghostly head above its shoulders, indicating where its head had until recently been located, and a jaunty arrow arcing across the drawing toward the space



above a second monkey body, where the first monkey's head is now situated. The drawing lends a tidy, businesslike neutrality to what must have been a chaotic and exceptionally gruesome operation, much the way airplane emergency exit cards give an orderly, workaday air to the interiors of crashing planes. White filmed the operation but wouldn't, despite protracted begging and wheedling, show me the film. He said it was too bloody.

That's not what would have gotten to me. What would have gotten to me was the look on the monkey's face when the anesthesia wore off and it realized what had just taken place. White described this moment in the aforementioned paper, "Cephalic Exchange: Transplantation in the Monkey": "Each cephalon [head] gave evidence of the external environment. . . . The eyes tracked the movement of individuals and objects brought into their visual fields, and the cephalons remained basically pugna-cious in their attitudes, as demonstrated by their biting if orally stimulated." When White placed food in their mouths, they chewed it and attempted to swallow it—a bit of a dirty trick, given that the esophagus hadn't been reconnected and was now a dead end. The monkeys lived anywhere from six hours to three days, most of them dying from rejection issues or from bleeding. (In order to prevent clotting in the anastomosed arteries, the animals were on anticoagulants, which created their own problems.)

I asked White whether any humans had ever stepped forward to volunteer their heads. He mentioned a wealthy, elderly quadriplegic in Cleveland who had made it clear that should the body transplant surgery be perfected when his time draws near, he's game to give it a whirl. "Perfected" being the key word. The trouble with human subjects is that no one wants to go first. No one wants to be a practice head.

If someone did agree to it, would White do it?

"Of course. I see no reason why it wouldn't be successful with a man." White doesn't think the United States will be the

likely site of the first human head transplant, owing to the amount of bureaucracy and institutional resistance faced by inventors of radical new procedures. "You're dealing with an operation that is totally revolutionary. People can't make up their minds whether it's a total body transplant or a head transplant, a brain or even a soul transplant. There's another issue too. People will say, 'Look at all the people's lives you could save with the organs in one body, and you want to give that body to just one person. And he's paralyzed!'"

There are other countries, countries with less meddling regulating bodies, that would love to have White come over and make history swapping heads. "I could do it in Kiev tomorrow. And they're even more interested in Germany and England. And the Dominican Republic. They want me to do it. Italy would like me to do it. But where's the money?" Even in the United States, cost stands in the way: As White points out, "Who's going to fund the research when the operation is so expensive and would only benefit a small number of patients?"

Let's say someone did fund the research, and that White's procedures were streamlined and proved viable. Could there come a day when people whose bodies are succumbing to fatal diseases will simply get a new body and add decades to their lives—albeit, to quote White, as a head on a pillow? There could. Not only that, but with progress in repairing damaged spinal cords, surgeons may one day be able to reattach spinal nerves, meaning these heads could get up off their pillows and begin to move and control their new bodies. There's no reason to think it couldn't one day happen.

And few reasons to think it will. Insurance companies are unlikely to ever cover such an expensive operation, which would put this particular form of life extension out of reach of anyone but the very rich. Is it a sensible use of medical resources to keep terminally ill and extravagantly wealthy people alive? Shouldn't we, as a culture, encourage a saner, more accepting

attitude toward death? White doesn't profess to have the last word on the matter. But he'd still like to do it.

Interestingly, White, a devout Catholic, is a member of the Pontifical Academy of Sciences, some seventy-eight well-known scientific minds (and their bodies) who fly to Vatican City every two years to keep the Pope up to date on scientific matters of special interest to the church: stem cell research, cloning, euthanasia, even life on other planets. In one sense, this is an odd place for White, given that Catholicism preaches that the soul occupies the whole body, not just the brain. The subject came up during one of White's meetings with the Holy Father. "I said to him, 'Well, Your Holiness, I seriously have to consider that the human spirit or soul is physically located in the brain.' The Pope looked very strained and did not answer." White stops and looks down at his coffee mug, as though perhaps regretting his candor that day.

"The Pope always looks a little strained," I point out helpfully. "I mean, with his health and all." I wonder aloud whether the Pope might be a good candidate for total body transplant. "God knows the Vatican's got the money. . . ." White throws me a look. The look says it might not be a good idea to tell White about my collection of news photographs of the Pope having trouble with his vestments. It says I'm a *petit bouchon fécal*.

White would very much like to see the church change its definition of death from "the moment the soul leaves the body" to "the moment the soul leaves the brain," especially given that Catholicism accepts both the concept of brain death and the practice of organ transplantation. But the Holy See, like White's transplanted monkey heads, has remained pugnacious in its attitude.

No matter how far the science of whole body transplantation advances, White or anyone else who chooses to cut the head off a beating-heart cadaver and screw a different one onto it faces a significant hurdle in the form of donor consent. A single organ

removed from a body becomes impersonal, identity-neutral. The humanitarian benefits of its donation outweigh the emotional discomfort surrounding its removal—for most of us, anyway. Body transplants are another story. Will people or their families ever give an entire, intact body away to improve the health of a stranger?

They might. It has happened before. Though these particular curative dead bodies never found their way to the operating room. They were more of an apothecary item: topically applied, distilled into a tincture, swallowed or eaten. Whole human bodies—as well as bits and pieces of them—were for centuries a mainstay in the pharmacopoeias of Europe and Asia. Some people actually volunteered for the job. If elderly men in twelfth-century Arabia were willing to donate themselves to become "human mummy confection" (see recipe, next chapter), then it's not hard to imagine that a man might volunteer to be someone else's transplanted body. Okay, it's maybe a little hard.